



# Electronics Technician

## Volume 1—Safety

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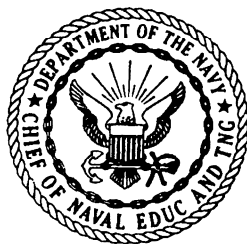
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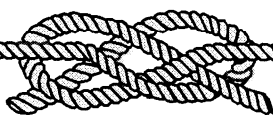
# **ELECTRONICS TECHNICIAN**

## **VOLUME 1 SAFETY**

**NAVEDTRA 12411-A**



*1997 Edition Prepared by  
GSEC Steven Wheeler*





# PREFACE

This training manual (TRAMAN), Electronics Technician, Volume 1, *Safety*, NAVEDTRA 12411-A, and its accompanying NRTC, are a part of a 9-part series of TRAMANS intended to provide Navy enlisted personnel with information pertinent to their assignments. The nine volumes areas follows: Volume 1, *Safety*; Volume 2, *Administration*; Volume 3, *Communications Systems*, Volume 4, *Radar Systems*; Volume 5, *Navigation Systems*; Volume 6, *Digital Data Systems*; Volume 7, *Antennas and Wave Propagation*; Volume 8, *Support Systems*; Volume 9, *Electro-Optics*.

Designed for individual study instead of formal classroom instruction, the TRAMANS provide subject matter that relates to the Electronics Technician rating. These volumes refer you to the appropriate Navy Electricity and Electronics Training Series (NEETS) modules and EIMB handbook. You may also be directed to review or study additional references commonly found in ET workspaces or used by Electronics Technicians. The accompanying NRTC consists of supporting questions designed to help you study the associated TRAMAN and referenced publications and to satisfy part of the requirements for advancement.

This training manual and the nonresident training course were prepared by the Naval Education and Training Professional Development and Technology Center for the Chief of Naval Education and Training.

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# **THE UNITED STATES NAVY**

## **GUARDIAN OF OUR COUNTRY**

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

## **WE SERVE WITH HONOR**

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations as we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

## **THE FUTURE OF THE NAVY**

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

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# SUMMARY OF THE ELECTRONICS TECHNICIAN TRAINING SERIES

This series of training manuals was developed to replace the *Electronics Technician 3 & 2* TRAMAN.

The nine volumes in the series are based on major topic areas with which the ET2 should be familiar. Volume 1, *Safety*, provides an introduction to general safety as it relates to the ET rating. It also provides both general and specific information on electronic tag-out procedures, man-aloft procedures, hazardous materials (i.e., solvents, batteries, and vacuum tubes), and radiation hazards. Volume 2, *Administration*, discusses COSAL updates, 3-M documentation, supply paperwork, and other associated administrative topics. Volume 3, *Communication Systems*, provides a basic introduction to shipboard and shore-based communication systems. Systems covered include man-pat radios (i.e., PRC- 104, PSC-3) in the hf, vhf, uhf, SATCOM, and shf ranges. Also provided is an introduction to the Communications Link Interoperability System (CLIPS). Volume 4, *Radar Systems*, is a basic introduction to air search, surface search, ground controlled approach, and carrier controlled approach radar systems. Volume 5, *Navigation Systems*, is a basic introduction to navigation systems, such as OMEGA, SATNAV, TACAN, and man-pac systems. Volume 6, *Digital Data Systems*, is a basic introduction to digital data systems and includes discussions about SNAP II, laptop computers, and desktop computers. Volume 7, *Antennas and Wave Propagation*, is an introduction to wave propagation, as it pertains to Electronics Technicians, and shipboard and shore-based antennas. Volume 8, *Support Systems*, discusses system interfaces, troubleshooting, sub-systems, dry air, cooling, and power systems. Volume 9, *Electro-Optics*, is an introduction to night vision equipment, lasers, thermal imaging, and fiber optics.

# CHAPTER 1

## NAVAL SAFETY

### HISTORY OF NAVAL SAFETY

Safety awareness in the Navy can be traced back to 1818. The old saying “hindsight is 20/20” probably came from a gunner who, in 1817, lit a candle in the powder magazine. His action not only sent him and his crew into orbit, but also helped introduce the first naval safety regulation. That regulation dealt with fire and the handling of black powder aboard ships. Since then, experience has played the major role in developing the safety programs of today’s Navy. Here is a brief listing of some major milestones in the history of naval safety:

- 1917—Safety engineers were assigned to each major naval shipyard.
- 1922—Safety programs for civilian employees were introduced at all naval activities.
- 1929—Enlisted personnel on shore duty were included in safety programs.
- 1947—The Navy Department Safety Council was organized under the Director of Safety of the Office of Industrial Relations (OIR). Its original mission was to coordinate safety procedures and to provide communications between the bureau safety engineers and the technical staff of the OIR safety branch. In 1957, the council’s mission was expanded to include the development and maintenance of the U.S. *Navy Safety Precautions Manual*, OPNAV 34P1 (superseded by OPNAVINST 5100.23, *Navy Occupational Safety and Health [NAVOSH] Program Manual*).
- 1951—The transition from propeller to jet aircraft helped the Secretary of the Navy (SECNAV) to establish the Naval Aviation Safety Council. In 1955, the title was changed to Naval Aviation Safety Center.
- 1963—The Navy was shaken by the loss of the USS *THRESHER* (SSN-593), in which 129 sailors were lost. A court inquiry was convened to examine the circumstances leading to and surrounding the incident. The court’s findings

resulted in the creation of the Submarine Safety Program (SUBSAFE). Its purpose was to impose high standards of quality control on submarine construction and operations. In 1964, the Chief of Naval Operations (CNO) established the Submarine Safety Center at the Submarine Base in New London, Connecticut, to examine and coordinate all matters of submarine safety.

- 1966-1967—The SECNAV tasked CNO to review the entire Navy Safety Program after a series of fires, collisions, and other mishaps involving surface ships resulted in over 200 deaths and more than 100 million dollars in damage. On 3 May 1968, as a result of CNO’s findings, the SECNAV established the Naval Safety Center.
- 1970—The Occupational Safety and Health Act (OSHA) of 1970 became law. Insofar as possible, this law assures safe and healthful working conditions for every working person in the nation.
- 1971—The Naval Safety Center assumed the responsibility for the Navy’s Defensive Driver Education Program.
- 1972—The Navy implemented its Motorcycle Training Course.
- 1973—The Commander, Naval Safety Center, was designated as the CNO Safety Coordinator (OP-09F), reporting directly to the Vice Chief of Naval Operations. This designation made the Naval Safety Center’s mission more specific and all-encompassing.

Now refer to the *Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat* (OPNAVINST 5100.19), chapter A2. Also read the *Standard Organization and Regulations of the U.S. Navy* (OPNAVINST 3120.32), chapter 7. The information in these chapters will enhance your knowledge of the NAVOSH program organization and

responsibilities and the naval safety program. When you have finished these reading assignments, return here and continue with this chapter.

## OVERALL NAVY PROGRAM

**The Assistant Secretary of the Navy (Installations and Environment):** The assistant Secretary of the Navy (Installations and Environment) is the designated occupational safety and health (OSH) official for the Department of the Navy (DON) and establishes, maintains, and updates the occupational safety and health program that implements the requirements of the Department of Defense (DoD) OSH policy issuances to provide protection for both civilian employees and the military personnel.

**Chief of Naval Operations (CNO):** The CNO is responsible for implementation and management of the NAVOSH Program and, in coordination with the Commandant of the Marine Corps, for mutual concern:

- Provides appropriate NAVOSH policy and standards for all commanders.
- Establishes appropriate planning, programming, qualified staffing, and budgeting for the NAVOSH Program.
- Issues the requirements for records maintenance.
- Conducts research and development to preclude occupational hazards or exposures from causing physical injury or degrading health status or work performance.
- Develops a program of periodic formal inspections of workplaces.
- Provides for job-related medical support.
- Develops procedures for prompt investigation of reports of unsafe or unhealthy working conditions and ensures corrective action is taken within appropriate time periods.
- Ensures personnel receive thorough and continuing training on NAVOSH matters.
- Adopts, develops, and reviews proposed alternate standards and promulgates NAVOSH standards.

**Fleet Commanders in Chief:** Because safety is an inherent responsibility of command, all aspects of the Navy Occupational Safety and Health Program shall be implemented through the chain of command. Fleet

Commanders are responsible for ensuring that their commanders, commanding officers, and officer in charge:

- Conduct and maintain an aggressive and comprehensive NAVOSH program.
- Assign safety responsibilities to qualified personnel as a primary duty billet where feasible, otherwise as a collateral duty billet with appropriate training provided. Where possible, assigned safety officers should remain in these positions for at least 1 year.
- Develop a NAVOSH management evaluation mechanism for afloat commands that is to the extent feasible integrated with the command inspection program and conducted by the chain of command.

**Type Commanders:** Oversight of subordinate commands' NAVOSH Programs and coordination of matters of mutual concern are the primary responsibilities of Type Commanders. Accordingly, Type Commanders will:

- Ensure that subordinate afloat commands implement the NAVOSH Afloat Program.
- Conduct periodic NAVOSH inspections of group commands and conduct or assist in NAVOSH inspections of squadrons and afloat commands. Inspectors at a minimum, should complete the Afloat Safety Officer Course (A-4J-0020) at the Surface Warfare Officers School (SWOS) or the Submarine Safety Officer Course (F-4J-0020), as appropriate. Appropriately trained civilian safety specialists may assist in these inspections.
- Coordinate and promote those aspects of the NAVOSH Program of mutual concern to forces afloat.
- Coordinate industrial hygiene support.

**Group Commanders will:**

- Conduct or assist in the conduct of periodic NAVOSH inspections of subordinate commands. Afloat units with industrial hygiene officers (IHOs) assigned should be inspected by the next higher echelon command having a professional NAVOSH representative.
- Assist afloat commanders and squadrons to ensure that afloat workplace NAVOSH

discrepancies beyond shipboard capability are identified in the Workload Availability Package.

- Establish uniform guidance for small ships to implement NAVOSH Program management requirements, as appropriate.
- Ensure that the group safety officer attends the Afloat Safety Officer Course, as appropriate, prior to or within 6 months of assignment.

**Squadron Commanders will:**

- Conduct or assist in the conduct of periodic NAVOSH inspections of afloat commands. Afloat units with IHOs assigned should be inspected by the next higher echelon command having a professional NAVOSH representative.
- Provide or coordinate NAVOSH assistance for subordinate afloat commands.
- Appoint a collateral duty safety officer.
- Establish uniform guidance for small ships to implement NAVOSH Program management requirements, as appropriate.
- Ensure that the squadron safety officer attends the Afloat Safety Officer Course of Submarine Safety Officer Course, as appropriate, prior to or within 6 months of assignment.

#### **Primary Program and Specified Support Areas:**

The higher the echelon administration and management of the Occupational Safety and Health Program is divided into primary program areas and specified support areas.

**The Commander, Naval Safety Center (COM-NAVSAFECEN):** Monitors safety and occupational health statistics and provides direct support and assistance to fleet units in safety matters upon request.

### **MISHAP CAUSES**

Although there are many definitions of a mishap, we chose this one as a starting point: A mishap is any *unplanned or unintentional event, no matter how serious, that stops or interrupts your work and results in personnel injury and/or property damage.*

There are three basic elements of a mishap:

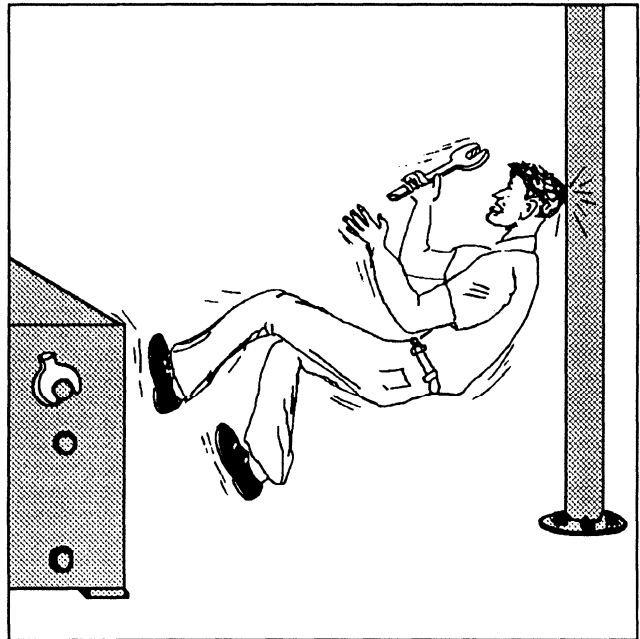
1. A mishap is an unplanned or unintentional event.

2. A mishap stops or interrupts work.
3. A mishap involves contact that causes injury or property damage.

Here is an example that illustrates the three basic elements of a mishap:

You're trying to loosen a large nut with a wrench. The nut is rusted tight. As you apply extra pressure to the wrench, the wrench slips. You stagger backward and strike your head on a stanchion behind you.

In this example, there were three distinct unexpected happenings: (1) the wrench slipped; (2) you staggered backward; and (3) you hit your head on a stanchion behind you. The last happening fits the definition of a mishap. It was unexpected; it interrupted your work; and, as you would agree, you made contact that caused personnel injury or property damage.



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Mishaps are a pain! This is especially true when, after a mishap has occurred, you look back and say "If only I" and finish with a "had," "had not," or "did not." With that in mind, it's important for you to understand that you are both the number one cause and the number one cure for mishaps.

We know you want to do the best job you can. However, do you associate *safest* with *best*? If not, you'd better start right now!

Two facts that form the basis of mishap prevention are (1) mishaps are caused, and (2) the only way to stop them is to prevent or eliminate the causes. The more you know about the causes of mishaps, the better equipped you will be to prevent them.

A practical definition of a mishap cause is anything and everything that contributed to the mishap. The most common causes of mishaps are (1) you, and (2) your environment. They could include:

- Your unsafe actions or the unsafe actions of your coworkers
- An impaired physical or mental condition of the people who caused or influenced the unsafe actions
- Any defective or otherwise unsafe tools, equipment, machines, materials, buildings, compartments, or other aspects of the work environment

Studies reveal that the cause of at least two of every three Navy mishaps are caused by either a *worker's failure to do (or not to do)* something, or a *worker's taking short cuts* when performing a task. We call this "human error." See figure 1-1. In other words, **YOU** cause most of your own mishaps.

The following are some of the many factors that can lead you to mishaps:

- Inadequate training and lack of job experience
- Inadequate or outdated procedures in technical publications
- Inadequate posting or listing of the safety precautions you should observe when performing a task
- Behavioral factors, especially negative types of motivation
- Medically related factors that reduce your ability to work safely
- Communication problems caused by a breakdown in passing, receiving, or understanding information
- Poorly designed equipment, such as improperly placed controls

Refer to the following excerpt from *Electronics Installation and Maintenance Book (EIMB), General*, section 3, paragraph 3-1.1, for a brief discussion of the causes and effects of mishaps.

"Most accidents are preventable. However, through ignorance or misunderstanding, there is a common belief that they are the inevitable result of unchangeable circumstances or fate. This belief is untrue because it fails to consider the basic law of "cause and effect" to which accidents are subject. In other words, accidents do not occur without a cause; most accidents are the direct result of some deviation from prescribed safe operating procedures.

A preventable accident may be traced to causes as basic as the heredity and early environment of the individual. These causes may be revealed in the form of personal characteristics which permit the individual to perform an unsafe act or permit a hazardous condition to exist; when an accident results, the cause and effect sequence is completed.

One purpose of safety rules is to remind the individual of the dangers inherent in the work. Training in the observance of safety precautions can be instrumental in avoiding preventable accidents and in maintaining a work environment which is conducive to accident-free operation. Operating procedures and work methods adopted with hazard prevention as a specific criteria do not expose personnel unnecessarily to injury or occupational health hazards. Accidents which are about to happen can be prevented if the "cause" is detected and appropriate remedial action is taken."

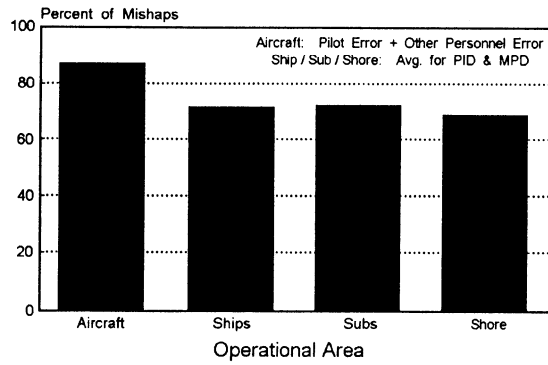
## **INADEQUATE TRAINING AND EXPERIENCE**

Many mishaps occur because of inadequate training and lack of job experience. You may find yourself assigned a task that is clearly beyond your skill level. This may be because of an operational requirement or an emergency that requires prompt action. Or, your supervisor may not be aware of your limitations.

These situations may cause you to misread instructions, take short cuts, or make other errors that could result in a mishap. Also, your chances of a mishap increase when you are not aware of the hazards associated with a particular task. It's this lack of awareness that can keep you from taking the necessary precautions.

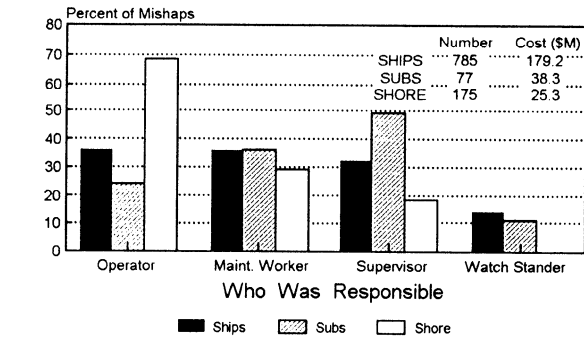
In simple English—(1) **DON'T TAKE SHORT CUTS**, and (2) **ASK FOR HELP**. If you think a task is too hazardous, it probably is. And before you attempt to do it, seek guidance and become familiar with its associated hazards.

### Estimated Frequency of Mishaps Involving Personnel Error



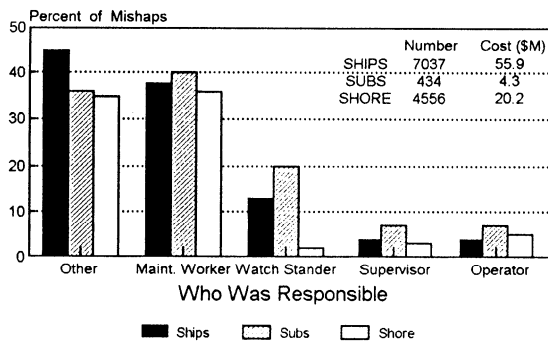
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### Distribution of Responsibility for Material Property Damage



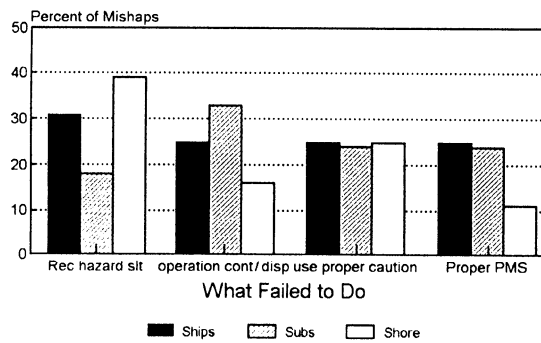
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### Distribution of Responsibility for Personal Injuries/Death



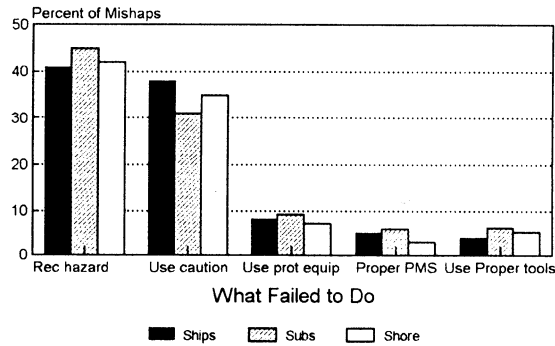
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### What Responsible Person Failed to Do that Caused Material Property Damage



1 Jan 86 - 31 Dec 90

### What Responsible Person Failed to Do that Caused Personnel Injuries/Death



1 Jan 88 - 31 Dec 90

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Figure 1-1.—Mishap causes.

## INADEQUATE OR OUTDATED PROCEDURES

When a mishap occurs, examine the procedures you followed just before the mishap. They may be in error or they may not provide enough detailed “how-to” information. Or, perhaps the technical manual was not updated when a piece of equipment was upgraded or replaced. As a result, you could inadvertently be using the wrong procedures for a particular task. If this is the case, *take the initiative* to complete the required paperwork to update the technical manual.

## INADEQUATE SAFETY PRECAUTIONS

You **must** be aware of the safety precautions associated with the job or task you are performing. They must either be posted in your work area or listed in the technical manual you’re using. If they aren’t available, you could be attempting something hazardous and not even know it. Make sure you read ALL applicable precautions. Even if you performed the task before and are familiar with it, it’s possible that new or revised precautions exist.

## BEHAVIORAL FACTORS THAT CAUSE MISHAPS

Your behavior is much more complex than the equipment you operate and maintain. Equipment, regardless of how it’s designed and powered, is predictable in its response to certain cues or signals. If a piece of equipment quits working, you can isolate the fault to a specific part with the use of test equipment and schematics. This isn’t true for you. Your behavior while performing a task is based on a combination of factors that come from your

- unique experiences,
- knowledge,
- attitude, and
- motivation.

Each of the above factors can affect your behavior regarding safety. Behavior that leads to a mishap is usually caused by undesirable *attitudes* and *motivations*.

• **Attitudes.** Attitudes are complex mental states that affect your reaction toward some object, event, or state of affairs. They cause you to form opinions and act in certain predictable ways, some favorable and others

unfavorable. Attitudes that do not support safe behavior hamper mishap prevention. And, they can also actually cause mishaps.

• **Motivations.** Motivations are incentives for specific acts. Your behavior is based on your motivation, and your motivation is shaped by your attitudes. Ensuring that you have positive motivations toward job safety is clearly a very complex problem. It’s complicated because you do not simply react to the basic needs of comfort, security, affiliation, and self-fulfillment. Your motivations on and off the job are also greatly affected by the attitudes, feeling, tensions, and emotions of the world around you. The following are some undesirable motivations that can lead you to mishaps in the workplace:

- Motivation to save time and effort
- Motivation to maintain personal comfort
- Motivation to gain approval and attract attention
- Motivation to express resentment

### Motivation to Save Time and Effort

You may sometimes be more concerned about doing a job quickly than you are about doing it safely. You may believe that saving time and effort will leave extra time for “shooting the breeze” or taking a break. Or, you may just find satisfaction in being the first to finish.

Motivations like these can cause incorrectly disassembled parts, jury-rigged equipment, incorrect use of tools, improper procedures, equipment damage, and injury. Sometimes a command’s operational commitments or a supervisor’s demands, if excessive, will lead to unsafe actions that you normally wouldn’t consider doing.

### Motivation to Maintain Personal Comfort

Sometimes you perform a job incorrectly because some of the actions required to perform the job properly cause you discomfort. For example, when a task calls for safety goggles, you may decide not to wear them because they’re uncomfortable. The same can apply to hearing protection, safety shoes, and safety harnesses. You may believe you aren’t susceptible to injury—but you are.

## **Motivation to Gain Approval and Attract Attention**

Even though you're normally cautious, you may use hazardous practices if you find the people around you use and approve of such practices. Some of your coworkers may do this because of a need for recognition and status. This is especially true if they are the type who receive more criticism than praise because their normal work habits are poor and hazardous. Such people may seek recognition by driving recklessly, drinking excessively, ignoring standard operating procedures, acting impulsively, disobeying orders, and showing off. While these actions may satisfy their immediate need for recognition, they also threaten mishap prevention efforts, and maybe your life.

## **Motivation to Express Resentment**

Many mishaps occur because of immature, irresponsible, or insubordinate behavior. This happens if you or a coworker becomes angry or resentful, and try to strike out at or get even with someone, such as your supervisor.

## **MEDICAL FACTORS THAT CAUSE MISHAPS**

Medical factors such as illness, physical impairment, alcohol abuse, fatigue, and motion sickness, can cause mishaps. These factors are frequently associated with either a high tempo of operations that prevents proper rest and nourishment or with events carried over from a recent return from leave or liberty.

### **Illness**

Your ability to work safely is sometimes affected by illness or the side effects of medicine. Temporary illness like colds, flu, dizziness, heat stress, and nausea can weaken your physical abilities.

They can either reduce your strength, stamina, and coordination, or disrupt your concentration, mental alertness, memory, and reasoning ability. These side effects of medication, such as drowsiness, sluggishness, and lack of coordination, can sometimes lead to mishaps.

### **Physical Impairments**

Any pre-existing physical impairment, such as a lower back injury, a slipped disc, or a hernia, may make

you more susceptible to mishaps. Mishaps can also stem from visual and hearing defects. Common visual problems include color blindness, faulty depth perception, farsightedness, and nearsightedness. Hearing defects cause mishaps if they prevent you from hearing instructions or a warning signal.

### **Alcohol Abuse**

Some people think alcohol is a stimulant. Nothing is farther from the truth. Alcohol is a chemical depressant. It acts as a general anesthetic for the parts of the brain that suppress, control, and inhibit thoughts, feelings, and actions. Alcohol typically impairs your judgment, gives you unrealistic confidence, slows your coordination, and degrades your performance. These effects are present whether you feel them or not. It's these effects that cause the risk-taking type of behavior that can lead you to unsafe acts that cause mishaps.

### **Fatigue**

Fatigue is not an all-or-nothing factor. It begins when you start a task, and it increases as you continue to perform the task. At some point during the task, fatigue can become great enough to impair your performance. It can decrease your work output, change your attitude, and reduce your motivation to observe safety precautions. But long before this happens, fatigue will decrease your awareness and reflex actions. It's at this point where mishaps can occur. The following are some symptoms of fatigue:

- Lower quality of performance
- Irritability
- Impatience
- Forgetfulness
- Confusion
- Higher number of errors

The following are some frequent causes of fatigue:

- Hard work, long hours, and lack of sleep.
- Environmental stress, such as heat, cold, noise, inadequate lighting, and vibration.
- Boredom and monotony.
- Change in routine. Suppose, for example, you're accustomed to working days and sleeping nights. If you switch to working nights and

sleeping days, you will probably experience fatigue.

The results of fatigue vary from person to person, but fatigue always reduces your mental alertness, increasing the chances of a mishap occurring.

### **Motion Sickness**

Anything that hinders your normal alert behavior can cause a mishap. Motion sickness can weaken, distract, disorient, and cause you severe nausea. In the early stages of motion sickness, you may experience a decrease in responsiveness and mental alertness. These symptoms may increase carelessness, which can lead to a mishap. Your reduced mental alertness will degrade your decision-making abilities. This, in turn, can increase your chances of having a mishap. As motion sickness progresses, you may be drowsy and have cold sweats and nausea.

### **COMMUNICATION PROBLEMS THAT CAUSE MISHAPS**

Mishaps can occur when there is a breakdown in the passing, receiving, or understanding of information. The most common communication problem is misunderstanding the message being sent to you. Your brain reacts to what *it thinks* it hears, not necessarily *what* it hears. Mishaps can also stem from language barriers. You can't understand a message if the person sending the message doesn't speak clearly enough.

### **EQUIPMENT DESIGN FACTORS THAT CAUSE MISHAPS**

Poorly designed equipment and improperly placed controls can cause mishaps. Controls that can't be reached quickly and easily, emergency controls protected by cumbersome interlocks, and displays that are difficult to read are examples of design problems that can cause mishaps. Now, refer to the *Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat*, OPNAVINST 5100.19, and read chapter A6.

Also read enclosure (4) *Afloat Safety Program* (OPNAVINST 5100.21). The information contained in these publications will enhance your knowledge of the overall Mishap Prevention Program.

## **MISHAP PREVENTION**

Why is mishap prevention necessary? Because the product of the Navy is national defense, the quality of your performance must be far superior to that of any potential adversary. The Navy's business is deadly serious. It's conducted by professionals, restricted to limited resources, and allows **no** room for waste. Mishaps produce waste. Therefore, when mishaps are reduced, waste is reduced, and readiness is improved.

The Navy also considers **your** safety to be as important as productivity. Unlike most civilian businesses whose safety efforts are directed at reducing on-the-job mishaps, Navy mishap prevention efforts give you complete coverage, both on and off the job, regardless of your duty status, location, or mission.

Mishap prevention is a vital part of your job. By preventing mishaps, you avoid injury to yourself and damage to your equipment. When you think of mishaps, you probably think of deaths. But in 1991, aboard ships and submarines and ashore, for every death, there were 111 mishaps that resulted in equipment damage or personal injury.

Mishap prevention is the process of eliminating mishap-producing causes. The goal of the Navy's mishap prevention program is to prevent mishaps from occurring or, once they have occurred, to prevent them from recurring. The Navy's mishap prevention program consists of activities directed to eliminate (1) unsafe acts of persons, and (2) unsafe mechanical, physical, or chemical working conditions.

The best way to prevent mishaps is to eliminate the factors that lead to mishaps. This can involve anything from a minute of extra effort by you that costs nothing to lengthy planning and work by many people at considerable cost. It all depends on the nature of the unsafe condition.

The authority to correct an unsafe condition may involve any level of the chain of command. The following four avenues are available to you.

**1. Order correction where authority permits.** If you have the authority to do so, don't delay ordering unsafe conditions corrected. Delay means exposure of other people to the unsafe condition. If you're uncertain about the best correction method, talk to your supervisor immediately.

**2. Report conditions to higher authority.** If you don't have the authority to correct the unsafe conditions, then promptly report the hazardous or

potentially hazardous conditions to you supervisor. Be ready to offer some suggestions about how to correct the unsafe condition. Your ideas may help to speed the correction.

**3. Correct the problem at the source.** Don't stop with just correcting the unsafe condition. Find its source and begin your corrective actions there. If you have the authority to correct the problem at the source, then do so. If the problem involves people, then point out the unsafe condition and correct the workers causing it. Hold on-the-spot training if needed. If you don't, you're inviting repetition of the unsafe practice.

**4. Take temporary precautions.** You may need to delay correcting an unsafe condition because of a shortage of funds, personnel, or equipment. If this happens, take whatever temporary precautions you need to protect both yourself and your coworkers from the unsafe condition until it can be corrected. These precautions may include

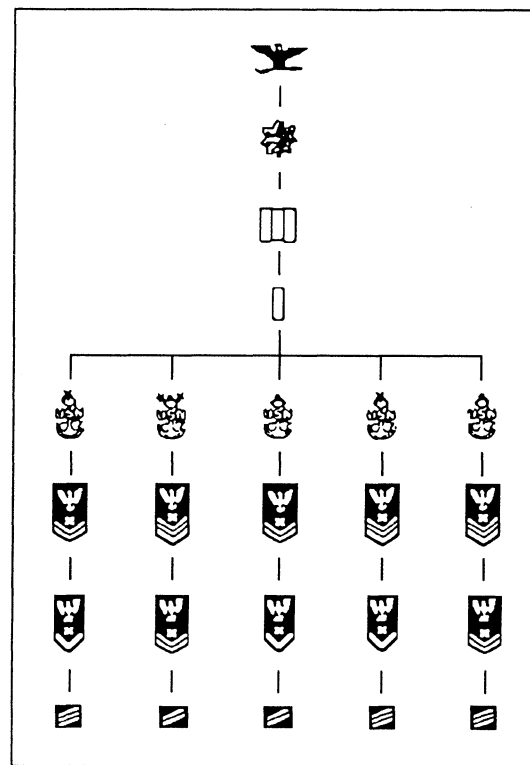
- securing the hazardous areas,
- disconnecting power sources,
- posting warning signs, and
- giving verbal warning to workers.

Whatever precautions are necessary, take them promptly to reduce the exposure of any hazardous condition to all personnel.

Here is an important final word about your responsibility to correct unsafe conditions. Sometimes an unsafe condition may arise that needs **IMMEDIATE** corrective action. This is especially true in situations that pose an immediate hazard to life or health. Don't delay because you may not have the authority to correct such an unsafe condition. In emergencies, **YOU HAVE IT!** Just be sure you don't put yourself or others in danger of being hurt. And, if you can't **SAFELY** correct the problem, inform your supervisor about it immediately.

## SAFETY RESPONSIBILITIES

From the commanding officer on down the chain of command to each individual, safety is everyone's business. Even though the safety program is ultimately the responsibility of the commanding officer, everyone must take part in the program for it to be successful. The following paragraphs briefly describe the specific responsibilities of the key individuals in a command's safety program.



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### COMMANDING OFFICER

Commanding officers are directly responsible for the safety of all personnel under their command. They cannot delegate this responsibility. However, they can give all officers and petty officers under their command enough authority to make sure everyone understands and follows all prescribed safety precautions.

### COMMAND SAFETY OFFICER

The command safety officer is responsible to the commanding officer for coordinating a complete safety program based on the objectives established by the commanding officer. Specifically, he or she performs the following safety related functions:

- Acts as principal advisor to the commanding officer on all internal safety matters
- Coordinates the commandwide safety program
- Promotes maximum cooperation for safety matters at all levels
- Ensures widest dissemination of all safety information

- Monitors submission of required safety and mishap reports to ensure accuracy and timeliness
- Maintains appropriate safety records and mishap statistics
- Serves as a member of the command's safety council and senior member of the enlisted safety committee
- Serves as the safety council recorder on aircraft carriers

## **DEPARTMENT SAFETY OFFICER**

Safety officers for each department support their department head's responsibilities in all safety matters. In doing this, each department safety officer performs the following functions:

- Keeps the department head informed of the status of the safety program within the department
- Performs mishap prevention functions as assigned by the department head
- Acts as the department's point of contact in coordinating and evaluating the ship's safety program
- Ensures that all hazardous conditions revealed through hazard reports are corrected
- Maintains a record of mishap and hazard reports
- Maintains direct liaison with the ship's safety officer

## **DIVISION SAFETY OFFICER**

The safety officer for each division is the division officer. On some small ships where the division officer is the department head, the division safety officer may be a senior enlisted member. In performing his or her duties, the division safety officer

- Keeps the department safety officer advised of the status of the safety program within the division
- Acts as the division's point-of-contact in coordinating and evaluating the ship's safety program

- Designates a senior petty officer, E-5 or above, as the division safety petty officer
- Investigates the division's mishaps and near-mishaps
- Makes sure that corrective action is taken on hazardous situations revealed by mishap and hazard reports and on recommendations made in mishap reports
- Ensures that all division personnel receive mishap prevention training

## **DIVISION SAFETY PETTY OFFICER**

The division safety petty officer reports directly to the division safety officer in all safety matters. In performing his or her duties, the division safety petty officer should

- Become thoroughly familiar with all safety directives and precautions concerning the division
- Conduct the division's mishap prevention training and maintain the related records
- Assist in mishap investigations as directed
- Make recommendations regarding the safety program to the division safety officer
- Assist the division safety officer in performing division safety duties
- Act as technical adviser on mishap prevention within the division
- Serve on the command safety committee

## **MAA/SAFETY FORCE**

MAA/Safety force personnel shall:

- Be roving inspectors for hazards that could result in injury to personnel or damage to equipment. All roving security patrols will have this additional duty.
- Assist the Safety Officer in keeping the Safety Program visible to all personnel.
- Carry out a system of internal reporting to focus command attention on material deficiencies and operating practices that jeopardize personnel and equipment.

## PERSONAL SAFETY RESPONSIBILITIES

So far, we've discussed the responsibilities of key personnel within your command's safety program. You may now be asking yourself "Where do I fit into the picture?" Remember, **safety is everyone's business**. Here are your specific responsibilities for safety— follow them wherever you are and no matter what you are doing:

1. Observe all the safety precautions related to your work or duty. You may have gotten by with being careless with safety rules in the past, but your luck will not hold out forever. If you continually cross a street without looking, eventually you'll get hit by a car.

2. Report any unsafe conditions or any equipment or material you think might be unsafe. Don't just walk by an open manhole or turn in a broken tool without saying anything about it. **Report it!** Remember, if you think it's unsafe, then it probably is.

3. Warn others of hazards that exist. If you see someone knowingly, or unknowingly, place himself or herself or others in danger, say something. If necessary, report the situation to your supervisor.

4. Report any injury or ill health to your supervisor. A splinter in your finger or a scratch on your leg, if treated immediately, will usually not cause any more trouble. But if left untreated, it may become infected, and what would normally be a 10-minute trip to sick call, may turn into a 10-day hospital stay.

5. Wear protective clothing whenever appropriate or required. If you're issued electrical safety shoes, wear them. It's cheaper and easier to replace a \$50 pair of shoes than it is to treat your injuries.

6. Be safety conscious. Always remain alert to dangers that may exist.

7. Always inspect equipment and associated attachments for damage before you use them. Make sure the equipment you are using is suited for the job. Check the safety precautions that pertain to each piece of equipment.

Remember, SAFETY should be your first thought before you begin a task and throughout the task, throughout the day.

## REMEMBER

### I AM YOUR WORST ENEMY

I am more powerful than the combined armies of the world. I have destroyed more men than all the wars of all the nations. I massacre thousands of people every year. I am more deadly than bullets, and I have wrecked more homes than the deadliest guns.

In the United States alone, I steal over 150 million dollars each year. I spare no one, and I find my victims among the rich and the poor alike, the young and the old, the strong and the weak. Widows and widowers know me to their everlasting sorrow. I loom up in such proportions that I cast my shadow over every field of labor.

I lurk in unseen places and do most of my work silently. You are warned against me, yet you heed me not. I am relentless, merciless, and cruel. I am everywhere: in the home, on the streets, in the factory, at the railroad crossing, on the land, in the air, and on the sea.

I bring sickness, degradation, and death, yet few seek me out to destroy me. I crush, I maim, I devastate—I will give you nothing and rob you of all you have.

I am your worst enemy—I AM CARELESSNESS.



# HAZARDOUS MATERIALS

What are hazardous materials? They are substances which, depending on their concentration, chemical or physical characteristics, or quantity, pose a threat to human health or the environment. Any flammable material, compressed gas, aerosol, toxic material or corrosive is a hazardous material. Cleaning solvents, paints, batteries, and floor wax are all examples of hazardous materials. To do our job, and maintain equipment and areas, we must use hazardous materials. Whether we use hazardous materials daily or infrequently, we need to know how to identify them and to understand their use, storage, and disposal.

### RECOGNIZING HAZARDOUS MATERIALS

All hazardous materials and hazardous material containers must be labeled. Manufacturers of hazardous materials must follow strict OSHA regulations on labeling. Each label must contain, at least:

1. The name of the material
2. The name and address of the manufacturer
3. The nature of the hazard

Hazardous materials we receive from the stock system, and even open purchase materials, must meet these requirements. You are not authorized to relabel properly labeled hazardous materials. If you dispense a hazardous material into an unlabeled container, you **must** indicate on the new container the same label information shown on the original container.

The Department of Defense (DOD) has a standard label for marking hazardous materials dispensed or produced by DOD agencies. You may also use this label to mark unlabeled containers. The label is called the Hazardous Chemical Warning Label, DD Form 2522, and is shown in figure 2-1. The information for this label is printed directly from the Hazardous Material Information System (HMIS) computer database.

You may also see Department of Transportation (DOT) shipping symbols on the outside of some hazardous material containers. These symbols, shown in figure 2-2 depict the hazard category of the material.

These symbols are used on outer packaging, and are also found on trucks and railway cars transporting those materials.

Types of materials that are either **Dangerous**, **Flammable** or **Combustible** are indicated by a diamond with applicable nomenclature that is red in color. Materials that are **Explosive** by nature are indicated by a diamond with applicable nomenclature and red coloring.





Types of materials that are either **oxidizing agents**, **organic peroxide**, or **radioactive** are indicated by a diamond with applicable nomenclature with yellow coloring. Materials that are either **poisonous gas**, **poison**, or **corrosive** are indicated by a diamond with applicable nomenclature and all black and white coloring. Non-flammable gases are indicated by a diamond with applicable nomenclature and green coloring. **Flammable solid** materials are indicated by a diamond with applicable nomenclature and red, blue, and white coloring.

You **must** read the labels on the hazardous materials you use. The label may also contain some handling precautions or other warnings that help you use the product safely.

### HAZARDOUS MATERIAL INFORMATION

Many hazardous materials, if not used properly, can be hazardous to your health. They can burn or irritate your skin, cause internal damage if you inhale them, or poison you if you ingest them. You must be aware of and follow safe handling, storage, and disposal procedures for the hazardous materials you work with.

OSHA regulations require employers to provide every employee with safety information on the hazardous materials they deal with at work. This law also pertains to federal civilian and military personnel. Manufacturers must provide hazardous material information for all hazardous materials they produce and must make a Material Safety Data Sheet (MSDS) available to the user for each hazardous material. In the Navy, MSDSs are provided in a computer database on compact disk-read only memory (CD-ROM) system

HAZARDOUS CHEMICAL WARNING LABEL						
1. CHEMICAL/COMMON NAME						
2. HAZARD CODE			3. NSN/LSN			
4. PART NUMBER						
5. ITEM NAME						
6. HAZARDS (x all that apply)		(1) Acute (Immediate)				(2) Chronic (Delayed)
		NONE	SLIGHT	MODERATE	SEVERE	
a. HEALTH						
b. CONTACT						
c. FIRE						
d. REACTIVITY						
7. SPECIFIC HAZARDS AND PRECAUTIONS (Including Target Organ Effects)						
(See MSDS for further information)						
8. PROTECT (X all that apply)		a. EYES	b. SKIN	c. RESPIRATORY		
9. CONTACT: a. COMPANY NAME						
b. ADDRESS (Street, P.O. Box, City, State, Zip Code and Country)						
c. EMERGENCY TELEPHONE NUMBER (Include Area Code)						
10. PROCUREMENT YEAR FOR HAZARDOUS CHEMICAL						

DD Form 2522 (1C), DEC 88

S/N 0102-LF-012-1100  
☆GPO: 1991-507-027

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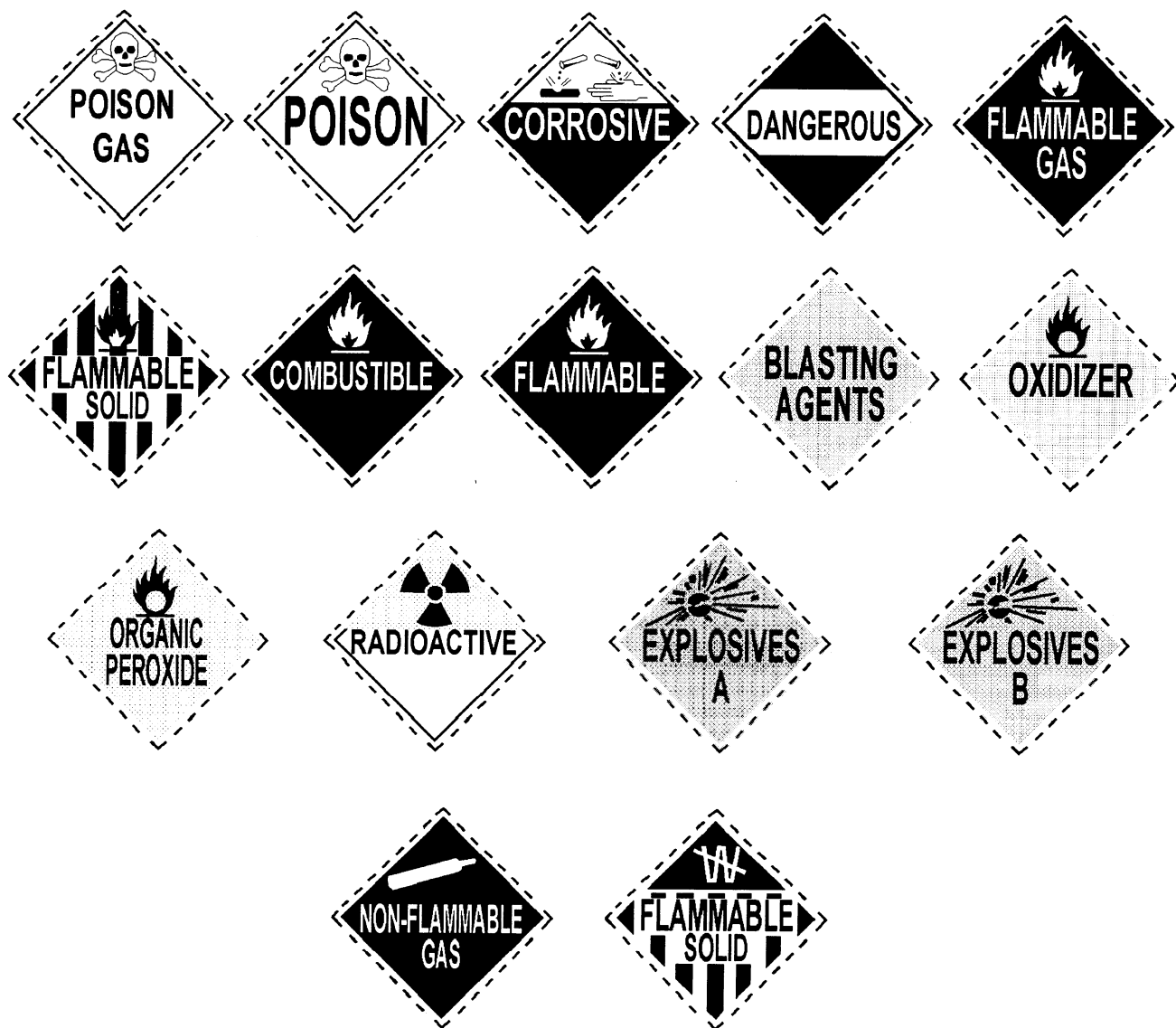
Figure 2-1.—Department of Defense Hazardous Chemical Warning Label, DD Form 2522 (1C).

called Hazardous Material Control and Management (HMC&M). This database contains several publications and a system called the Hazardous Material Information System (HMIS). The HMIS provides over 70,000 MSDSs for materials used within the Department of Defense.

The MSDS must be available to any user of hazardous material. CD-ROM systems with the HMC&M are provided on board every ship and shore station. The MSDS is used to train hazardous material

users on the hazards and precautions of that material. MSDs contain:

1. General information, including an emergency phone number
2. Ingredients and identity information
3. Physical/chemical characteristics
4. Fire and explosion hazard data
5. Health and hazard data, including first aid



ETV10005

Figure 2-2.—Department of Transportation hazardous material shipping symbols.

6. Precautions for safe handling and use
7. Control measures, including protective equipment
8. Transportation data
9. Disposal data
10. Label data

Your Hazardous Material Control Program Manager, Hazardous Material/Hazardous Waste Coordinator, or Safety Officer can provide you with MSDSs upon request. Ashore, the MSDSs for a work center will be located within that work area. Aboard ship, the MSDSs are available through your supervisor.

Safety information on hazardous materials is also available in chapter C23 of *Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat*, OPNAVINST 5100.19.

### SAFETY PRECAUTIONS FOR HAZARDOUS MATERIALS

You **must** follow the prescribed safety precautions for the hazardous materials you use or handle in your workplace. There are requirements for personal protective equipment, spill response, and disposal of waste that you need to know. This section will cover safety precautions for the following types of materials

commonly used or handled by Electronics Technicians: *solvents, aerosol containers, polychlorinated biphenyls, batteries, and vacuum tubes.*

## SOLVENTS

Varnishes, lacquers, cleaning fluids, and some paints contain solvents that can ignite at relatively low temperatures. Such materials pose a serious fire hazard. Some solvents give off toxic vapors that are harmful if you inhale them. Some will also cause serious problems if they come in contact with your skin.

Many solvents are used in the day-to-day maintenance of electronic equipment. The safest solvents are those that dissolve in water (water-based). If water-based solvents won't work, the two most popular non-water-based solvents are *trichloroethane* and *methyl alcohol*. Both of these are **EXTREMELY** flammable. Use these only when you have adequate ventilation.

When you use hazardous paints or solvents, always follow these safety precautions:

- 1 . If you spill them, **wipe them up immediately.**
- 2 . Place rags or other items you use to clean them up **in a separate, covered container.**
- 3 . **Use** protective clothing, goggles, gloves, or other appropriate **safeguards** to prevent the paints or solvents from getting on your skin or in your eyes.
- 4 . Have **accessible fire-fighting equipment nearby.**
- 5 . Have **adequate ventilation.**
- 6 . **Dispose** of the paints and solvents when you no longer need them. Make sure you dispose of them properly. If you are unsure of the disposal procedures, check with the safety officer.
- 7 . Store flammable solvents in approved flammable storage lockers. Make sure you store flammable and corrosive materials separately.
- 8 . **Do Not** use carbon tetrachloride. This is a highly toxic compound and is banned from use. Use trichloroethane instead.
- 9 . **Do Not** smoke or use an open flame or allow anyone else to do so in areas where paint, varnishes, lacquers, or solvents are being used.

10. **Do Not** breathe the vapors of any cleaning solvent for prolonged periods. If you don't have proper ventilation, use a respirator.
11. **Do Not** spray cleaning solvents on electrical windings or insulation.
12. **Do Not** apply cleaning solvents to heated equipment, since this could cause a fire.

## AEROSOL CONTAINERS

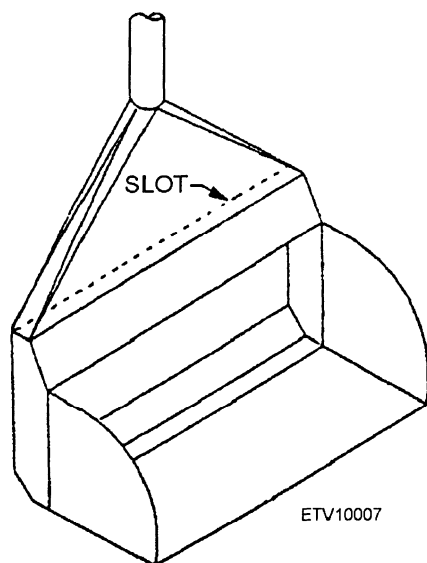
Aerosol containers are everywhere. You use them to groom your hair, to clean and freshen your living quarters, and to paint parts of the equipment you work on. When properly used, aerosol containers will dispense their chemicals quickly and effectively. But if they're misused, they can hurt you and cause damage to your surroundings. To prevent this, you must be aware of the dangers of aerosol containers and how to protect yourself from them.

Before using any aerosol container, read the label on the container. It usually has instructions on how to use, store, and dispose of the container safely. **Do Not** ignore these instructions. If you do, you may become sick from the toxic effects of the chemicals in the container. Or, even worse, you may be seriously injured if the container explodes.

Here are some basic rules to follow when using aerosol containers:

- 1 . Make sure you **have plenty of ventilation** when you use aerosols that contain dangerous or toxic gases. If you must use such aerosols when ventilation is not adequate, wear the appropriate respiratory equipment.
- 2 . Dispose of the containers **according to the instructions of your supervisor.** Some aerosol containers are considered hazardous waste.
- 3 . **Keep** all aerosol **containers away from** open flames, sunlight, heaters, and other possible sources of **heat.**
- 4 . **Do Not** spray paint or other protective coatings on warm or energized equipment. You may cause a fire.
- 5 . **Do Not** spray any paints or solvents on your skin. Some liquids in aerosol containers may burn you, while others may cause a skin rash.
- 6 . **Do Not** dent or puncture these containers. They are pressurized and can explode if dented or punctured.

- 7 **Do Not** store these containers in heated areas where temperatures can exceed the recommended storage temperature on their labels. Aboard ship, all aerosols are considered flammables and must be stored in a flammable liquid storage compartment or cabinet.
- 8 **Do Not** discard these containers in wastebaskets that will be emptied into an incinerator; they could explode.



## POLYCHLORINATED BIPHENYLS (PCBs)

Polychlorinated biphenyls (PCBs) are toxic chemicals belonging to the chlorinated hydrocarbon group of substances. They range in form and appearance from oily liquids to crystalline solids and hard transparent resins. These chemicals exhibit many favorable physical and chemical properties, including high heat capacity, chemical stability, noncorrosivity to metals, low flammability, low vapor pressure, and low electrical conductivity. They have, therefore, been used extensively as insulators and coolants in electrical equipment.

Any PCBs in use aboard ship will typically function as insulating fluids or coolants within electrical equipment. (The chemicals might occasionally be found in totally-enclosed hydraulic and heat transfer systems.)

Remember, these chemicals are **toxic**. That means they can be harmful to your health or even deadly. Their adverse effects can result from either brief or repeated exposure. The effects from short-term contact with high

concentrations of PCB vapors or liquids include eye, nose, and throat irritation, headaches, and a skin rash known as chloracne. Repeated exposure can result in severe skin irritation, respiratory irritation, digestive tract damage, and damage to the liver. Systemic intoxication, that is, an adverse effect to your entire bodily system, can result from severe overexposure. Systemic intoxication is indicated by nausea, vomiting, weight loss, jaundice, and abdominal pain, and can be fatal.

To protect all personnel, all equipment and cabinets containing in-service small and large PCB capacitors should be marked with the label shown in figure 2-3.

You can find additional information on PCBs in the *Shipboard Management Guide for Polychlorinated Biphenyls (PCBs)*, NAVSEA S9593-A1-MAN-010. Although we do not require that you read this publication, we highly recommend that you do so.

## BATTERIES

A battery consists of a group of cells that provide a source of direct-current electrical power. Batteries are used in automobiles, boats, aircraft, ships, submarines, lighting equipment, and portable and stationary electrical and electronic equipment. They can be used as main power sources or as secondary or backup power sources. Some batteries are rechargeable and some are not.

Batteries can be dangerous. If used or handled improperly, they can explode, release toxic gases, or leak hazardous chemicals. This section gives you the



Figure 2-3.—Sample 4" x4" EPA-required label.

safety precautions for the following six types of batteries ETs are most likely to see:

1. Carbon-zinc
2. Manganese-dioxide alkaline-zinc
3. Mercuric-oxide
4. Lithium
5. Lead-acid
6. Nickel-cadmium

### Carbon-Zinc Dry Cell Battery

This is a very common battery in the Navy. It has a zinc outer container, a carbon center electrode, and a chemical paste for the electrolyte. It is usually sealed in a cardboard or plastic casing.

There are three important safety precautions concerning using, storing, or disposing of carbon-zinc batteries:

1. **Do Not** store carbon-zinc batteries in electronic equipment for extended periods. The corrosive electrolyte could leak out of the battery and damage the equipment.
2. **Do Not** throw carbon-zinc batteries into a fire; they could explode. Keep them away from incinerators.
3. **Do Not** throw carbon-zinc batteries overboard while at sea. These batteries contain metal pollutants. Store them on board (in a steel container) until you can properly dispose of them ashore.

### Manganese-Dioxide Alkaline-Zinc Cell Battery

Commonly called an *alkaline* battery, this type of battery is similar to the carbon-zinc battery. The only difference is the type of electrolyte used. You'll find these batteries in portable electronic equipment. The safety precautions for alkaline batteries are identical to the safety precautions for carbon-zinc batteries.

### Mercuric-Oxide Zinc Cell Batteries

Commonly called *mercury cells*, these batteries are small and powerful. They have longer shelf life than the two previous types of batteries. They were first used to power miniature equipments of the space program. Today these batteries are used in electronic test

equipment, cameras, hearing aids, periscope cameras, missiles, cryptographic equipment, and sonar devices.

Mercury cells are safe when used properly. But, if they're misused, **BOOM!**, they could explode. Use the following safety precautions for mercury batteries:

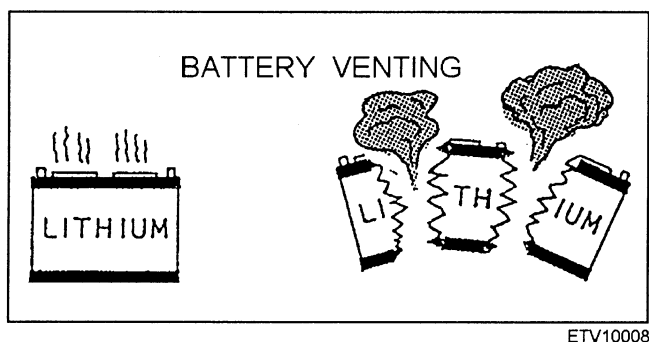
1. **Do Not** place a direct "short circuit" on a mercury cell.
2. **Do Not** discharge a mercury cell after its voltage falls below 70 percent of its original voltage, or after it fails to operate the equipment it is in.
3. **Do Not** leave the battery switch on when the equipment isn't in use, or after the mercury cell fails to operate the equipment.
4. **Do Not** expose mercury cells to temperatures over 400 degrees Fahrenheit.
5. **Do Not** keep exhausted mercury cells. Discard them as soon as possible. If you're at sea, store them temporarily under water in a steel container until you can dispose of them properly ashore. When you store exhausted mercury cells, never purposely puncture their jackets.

### Lithium Cell Batteries

Lithium batteries are high-energy, long-lasting batteries with a longer shelf life than most other batteries. They are making their way into electronic equipments. They're used in computers, communications and cryptographic equipments, torpedoes, and missiles. Unfortunately, lithium batteries can be very dangerous. They've been known to release toxic gases or to explode. If you handle lithium batteries, observe the following safety precautions to prevent injury to yourself and damage to your equipment:

1. Use **only** lithium batteries that are approved for use in your equipment.
2. Store them in **cool, well-ventilated areas** away from flammable items.
3. **Always observe polarity** when you install them.
4. **Do Not** pierce, short-circuit, recharge, crush, cut, burn, drop, dismantle, modify, or otherwise carelessly handle them.
5. **Do Not** leave them in equipment that won't be used for long periods.
6. **Do Not** throw them away with daily trash. Dispose of them properly. See the

*Environmental and Natural Resources Program Manual*, (OPNAVINST 5090.1), for more disposal information on lithium batteries.



If you use lithium batteries on a daily basis, we recommend that you get a copy of the *Technical Manual for Batteries, Navy Lithium Safety Program Responsibilities and Procedures*, NAVSEA S9310-AQ-SAF-010, and read through it.

### Lead-Acid Cell Batteries

This is the most widely used wet-cell battery. It is also one of the most dangerous batteries to use and maintain. Lead-acid batteries use sulfuric acid, and their battery gases (mainly hydrogen) are extremely explosive. You'll see this battery in automobiles and large backup power systems.

Remember, lead-acid batteries are very dangerous. To prevent injury to yourself, you should use the following safety precautions:

- 1 . **Always** keep open flames and sparks of all kinds away from lead-acid batteries.
- 2 . Be **sure** to have proper ventilation when you charge lead-acid batteries to prevent the build-up of hydrogen gas.
- 3 . Follow the manufacturer's instructions when charging lead-acid batteries.
- 4 . Handle battery acid (electrolyte) **VERY** carefully. This material is highly corrosive to the skin and eyes and requires full body protection.
- 5 . Keep the battery acid **above** the tops of the separators.
- 6 . Use **only** pure, distilled water when adding liquid to lead-acid batteries.

- 7 . **Do Not** operate lead-acid batteries in temperatures over 125 degrees Fahrenheit (52 degrees Celsius).
- 8 . **Do Not** connect or disconnect charging connections when charging current is flowing.
- 9 . **Do Not** short-circuit lead-acid battery terminals.
- 10 . **Do Not** pour water into battery acid; always pour the acid into the water. And, make sure you wear appropriate skin and eye protection whenever you handle battery acid.
- 11 . **Do Not** put or allow salt water into a lead-acid battery. It will create an extremely toxic chlorine gas.

### Nickel-Cadmium Cell Batteries

Commonly known as **NICADs**, nickel-cadmium batteries are used in most cordless, rechargeable equipment, such as flashlights, cordless drills, and soldering irons, and in portable stereos.

The following safety precautions for NICADs are relatively simple:

- 1 . Charge NICADs in series, **never** in parallel.
- 2 . **Always** follow the manufacturer's instructions for charging NICADs.
- 3 . **Do Not** expose NICADs to temperatures over 113 degrees Fahrenheit (45 degrees Celsius).
- 4 . **Do Not** short-circuit NICADs.
- 5 . **Do Not** store NICADs and lead-acid batteries in the same container or in the same area.
- 6 . **Do Not** dispose of NICADs by throwing them overboard. Temporarily store exhausted cells in a steel container until you can dispose of them properly ashore.

### VACUUM TUBES

There are basically two categories of vacuum tubes: (1) *electron tubes*, and (2) *cathode-ray tubes*. There are certain safety precautions you need to follow when working with or handling vacuum tubes. The following paragraphs provide a brief discussion on the safety precautions for each category of tube.

Electron tubes are fairly rugged devices. Most of them can handle the shocks and knocks of everyday use. However, they are **not** indestructible. Most electron tubes contain a near vacuum enclosed by glass. Any excessive stress, like dropping the tube, may cause the glass to shatter, causing an **IMPLOSION**. An implosion is the opposite of an explosion. When the glass shatters, the outside air rushes into the tube to fill the vacuum. As the air rushes into the tube, it carries the glass fragments with it, right on through the center of the tube and out the other side. If you're in the path of these flying fragments, you could be seriously injured. So, handle **ALL** electron tubes with care.

Some electron tubes contain radioactive material. These must be handled with **EXTRA** care. Radioactive material is added to some electron tubes to aid ionization. Unbroken, the radioactive tubes are as safe as other electron tubes. This is because the tube's radioactive material emits slow-moving particles that are contained within the tube's thick glass envelope. But breaking the tube will expose the hazardous radioactive material.

To prevent injury to yourself or others, use the following safety precautions when handling either regular or radioactive tubes:

1. Handle **ALL** electron tubes, whether radioactive or not, with **EXTREME** care.
2. Immediately put any electron tube that has just been removed, whether radioactive or not, into a protective container, such as its shipping container.
3. Let your supervisor know immediately if a radioactive electron tube is broken.
4. **Seal off a radioactive-contaminated area immediately** so no other personnel are exposed to the radioactive material.
5. Treat **all** bad or damaged radioactive electron tubes as radioactive waste and dispose of them accordingly.
6. **Do Not** remove a radioactive tube from its shipping container until you're ready to install it.
7. **Do Not** let your skin come in contact with **any** radioactive fragments. If it does, wash yourself thoroughly with soap and water and get medical attention.

Cathode-ray tubes (CRTs) are everywhere. They're used in televisions, desktop computers, radars, and electronic warfare systems. You'll probably maintain electronic systems that use CRTs. So, it's important for you to know about their hazards, and how to handle and dispose of them.

• **CRT hazards:** CRTs can be extremely hazardous. A CRT consists of a large glass envelope that maintains a high vacuum inside. It also has a toxic phosphor coating on its face. CRTs are under great atmospheric pressure. For example, a 10-inch CRT is subject to nearly 2,000 pounds of force. Of that, 1,000 pounds is felt on the tube's face alone. Therefore, if you break the glass envelope, it will cause a violent implosion.

When a CRT breaks, high external pressure causes it to implode (burst inward). As a result, all the glass fragments, metal parts, and toxic phosphor are expelled violently.

A CRT can also be hazardous when it's energized. This is because it carries a **very high voltage** and **emits X-rays**.

• **CRT handling:** To protect yourself from serious injury, you must never do anything that would cause the CRT's glass envelope to break and cause an implosion. When handling CRTs, follow these precautions:

1. Always follow the manufacturer's handling instructions.
2. Keep a new CRT in its shipping carton until you're ready to use it.
3. When you remove a defective CRT, place it in a shipping carton **immediately**.
4. Wear gloves and goggles.
5. **Do Not** remove a CRT until the high-voltage anode has been discharged.
6. **Do Not** strike or scratch the surface of a CRT's glass envelope.
7. **Do Not** stand in front of a CRT when you install it. If the CRT should implode, the electron gun in its neck could be propelled at a very high velocity through the face of the tube and into your body.
8. **Do Not** carry a CRT by its neck.
9. **Do Not** come in contact with phosphor coating; it is extremely toxic. If a CRT should break,

clean up the glass fragments very carefully. And, if you touch the phosphor, go to medical.

- **CRT disposal:** CRTs are disposed of by shipping them back to the manufacturer, or by discarding them locally. If you ship a CRT back to the manufacturer, put it in the shipping container intact. If you dispose of it locally, follow the procedure that has been prescribed by your safety officer.

## HAZARD REPORTING

The reporting of unsafe or unhealthful conditions in the work place is extremely important. Each identified/validated hazard shall be assigned a Risk Assessment Code (RAC) by the activity safety office. The RAC represents the degree of risk associated with the deficiency. Hazard severity categories shall be assigned by Roman numeral according to the following criteria.

1. **Category I—Catastrophic:** The hazard may cause death, or loss of a facility.
2. **Category II—Critical:** May cause severe injury, severe occupational illness, or major property damage.
3. **Category III—Marginal:** May cause minor injury, minor occupational illness, or minor property damage.
4. **Category IV—Negligible:** Probably would not affect personnel safety or health, but is nevertheless in violation of a NAVOSH standard.

*Mishap Probability* is the term used to describe the probability that a hazard will result in a mishap, based on an assessment of such factors as location, exposure in terms of cycles or hours of operation, and affected population. Mishap probability shall be assigned an Arabic letter according to the following criteria:

1. Subcategory A—Likely to occur immediately or within a short period of time.
2. Subcategory B—Probably will occur in time.
3. Subcategory C—May occur in time.
4. Subcategory D—Unlikely to occur.

## GENERAL STOWAGE REQUIREMENTS

Proper stowage of hazardous material is essential to ship and personnel safety. The supply department and individual work center personnel are responsible for proper stowage of hazardous material in areas under their cognizance. For answers to your questions concerning hazardous material stowage, consult your supervisor, supply officer, or your hazardous material/hazardous waste coordinator.

Hazardous materials aboard ship are typically packaged in cases or allotments of individual containers.

Do not store hazardous materials in heat producing areas, or near heat-producing items. Shield hazardous material stored on the weather deck or in exposed areas from direct sunlight.

Temporary stowage of hazardous material in work spaces should be limited to the quantity necessary for one work shift.

We recommend that you get a copy of *Naval Ships' Technical Manual*, Chapter 670, "Stowage, Handling, and Disposal of General Use Consumables," and read sections 3 through 6 to enhance your knowledge on stowage of the material covered in this chapter. Additional information is also provided in chapter C23, of the *NAVOSH Program Manual for Forces Afloat*, (OPNAVINST 5100.19).

